CLEANING APPARATUS FOR PILLARED DEVICES

FIELD OF THE INVENTION

[0001] The present invention relates to a cleaning apparatus for pillared device, and more particularly to a cleaning apparatus for carrying out two cleaning procedures upon the pillared device.

DESCRIPTION OF THE PRIOR ART

[0002] Thin polyimide (PI) film is one of the most commonly employed alignment films to align liquid crystal (LC) molecules with predetermined pre-tilts. In the art, a proper orientation relationship between the liquid crystal molecules and the orientation layer will benefit to achieve a lower addressing voltage of the pixels in the LC display. However, when the PI film is rubbed by a velvet cloth, microscopic groves are usually generated on the PI layer and make the molecules line up along the rubbing direction. Such an damage may cause the angular arrangement of the surface liquid crystals into an unexpected pattern, forexample a twisted or a helical pattern, for sustaining basic paralleling among LC molecules.

[0003] Referring to FIGS. **1A** to **1C**, a polyimide solution carried by a roller **10** is coated onto a transparent electrode **52**, i.e. an indium tin oxide (ITO), rested on a glass substrate **50**. Then, the polyimide solution on the transparent electrode **52** is firstly pre-baked to transform into a gel polyimide film **30**. Further, the gel polyimide film **30** is baked at a temperature of 200 to 300℃ for 10 to 30 minutes, for forming a solid polyimide film **54**.

[0004] When the roller **10** for coating the polyimide is used for a period of time, crystals of the polyimide may residue on the roller **10** by static electricity , which the residual crystals will result in various imprints on the roller and which the imprints will lead to damage the transparent electrode 52.

[0005] In general, the roller **10** with a substantial amount of the imprints is no more usable and needs to be sent back to its original manufacturer for necessary cleaning and maintenance. Definitely, such a management upon an imprinted roller 10 will sacrifice both the service time and manufacturing cost.

[0006] In the art, an organic solvent, e.g. an N-methyl-2 pyrrolidinone (NMP), can be applied to solve part of the problem on the roller 10 described above, yet the imprints thereon can not be really removed. If the roller **10** is re-used to coat the polyimide solution on the transparent electrode **52**, the thickness of the polyimide film will be

unstable and a phenomenon of color mura will be generated.

[0007] It is noted that an alkali, such as a potassium peroxide, can be used to remove the imprints completely. In the present process, however, no appropriate platforms can be applied to clean a pillared device with an alkali/acid. In addition, the alkali/acid is highly harmful to operators if the pillared device is cleaned by artificially wiping up the particles adhere thereto. Therefore, the performance and setup of the cleaning process by using alkali/acid can be better controlled for sure by an appropriate apparatus.

SUMMARY OF THE INVENTION

[0008] Accordingly, an object of the present invention is to provide a cleaning apparatus for pillared devices.

[0009] Another object of the present invention is to provide a cleaning apparatus for performing two cleaning procedures to pillared devices.

[0010] A cleaning apparatus of the present invention can comprise an outer tank, an inner tank, a removable lid and a plurality of nozzles. Upper edges of opposing sidewalls of the outer tank include respective openings. The inner tank for containing a first cleaning solution is located within the outer tank. Rested on a top of the outer tank is the removable lid. The nozzles are constructed in the interior of the lid to spray a second cleaning solution directly onto a pillared device.

[0011] The present invention can also disclose a method of cleaning the pillared device by using the above cleaning apparatus. Firstly, at least a portion of the pillared device is dipped into the first cleaning solution in the inner tank, with a shaft protruding from two ends of the pillared device to pass through the openings of the outer tank. Next, the lid covers the top of the outer tank. When the shaft is turned, the pillared device can rotate to react with the first cleaning solution. The first cleaning solution is released out of the first cleaning tank after cleaning the pillared device. Lastly, a second cleaning solution from the nozzles is sprayed directly onto the pillared device to dilute the remained first cleaning solution.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated and understood by referencing the following detailed description in conjunction with the accompanying drawings, wherein:

[0013] FIG. **1A** is a schematic diagram of coating the polyimide solution onto a transparent electrode by using a roller in accordance with the prior art;

[0014] FIG. **1B** is a schematic diagram of performing a pre-baking to the polyimide solution in accordance with the prior art;

[0015] FIG. **1C** is a schematic diagram of performing a baking to the polyimide film in accordance with the prior art;

[0016] FIG. **2** is a perspective side view of a preferred cleaning apparatus in accordance with the present invention;

[0017] FIG. **3** is a side view showing an outer tank and an inner tank in accordance with the present invention; and

[0018] FIG. **4** is a side view showing a pillared device mounted on the cleaning apparatus in accordance with the present invention.

DETAILED DESCRIPTION OF THE PERFERRED EMBODIMENTS

[0019] The invention disclosed herein is directed to a cleaning apparatus for pillared devices. Also, the invention is further directed to a method of cleaning the pillared devices by using the cleaning apparatus. A preferred embodiment of the present invention is now described in detail below.

[0020] Referring to FIG. **2**, a preferred cleaning apparatus **100** can comprise a base **102**, an outer tank **110**, an inner tank **120**, a removable lid **130**, a plurality of nozzles **140**, a set of bolsters **150**, a motor **160** and a tail stock **170**. The outer tank **110** is disposed upon the base **102**, in which upper edges of opposing sidewalls, **110a** and **110b**, of the outer tank **110** further include respective first openings **110c**. The first openings **110c** can allow a shaft extending out from two ends of a pillared device (not shown) to pass through. In the embodiment of the present invention as shown, the opening **110c** is preferably arched. Definitely, in other embodiments of the present invention not shown here, the profile of the opening can be a half-oval, a half-circle, or any shape that can be applied to sustain the extending shaft of the pillared device. Also, in the present invention, the pillared device can be an optoelectrical device, a solid shaft, or any having a pillar shape.

[0021] The inner tank **120** positioned within the outer tank **110** is used to contain the pillared device. When the cleaning apparatus **100** performs a cleaning process to the pillared device, a first cleaning solution is poured into the inner tank **120**. In one preferred embodiment of the present invention, the inner tank **120** can be a semi-cylindrical shell so as to minimize the amount of the first cleaning solution. Still referring to FIG. **2**, opposing sidewalls **120a** and **120b** of the inner tank **120** can be formed as parts of sidewalls **110a** and **110b**. Also, the inner tank **120** is supported above

the floor **110d** of the outer tank **110**.

[0022] Referring to FIG. **3**, between the bottom **120c** and the sidewall **120a** exists an angle θ since the area of the sidewall **120a** is deeper than that of the sidewall **120b**. Now back to FIG. **2**, a first outlet **120d** is located between the bottom **120c** and the sidewall **120a**. One end of a conduit **120e** is connected with the first outlet **120d**, whereas the other end of the conduit **120e** is extended down out of the outer tank **110**. Upon such an arrangement, the first cleaning solution in the inner tank **120** can be released out of the outer tank **110** through the first outlet **120d** and the conduit **120e** after cleaning the pillared device.

[0023] In a preferred embodiment of the present invention, the level of the base **102** can be adjusted and a second outlet **110e** can be created at a low-lying area of the floor **110d**, so that the cleaning solutions in the outer tank **110** can be discharged therethrough.

[0024] As shown in FIG. **2**, the lid **130** can be moved to cover the top of the outer tank **110**. On a sidewall **130a** of the lid **130,** a transparent window **130b** can be included to allow operators to monitor the proceeding of the cleaning process. In one embodiment of the present invention, a sealant can be further utilized at the conjunctions between the transparent window **130b** and the sidewall **130a** so as to prevent cleaning solutions within the cleaning apparatus **100** from leaking out therethrough while performing the cleaning process.

[0025] A piping **145** passing through the lid **130** is constructed high in the interior **130d** thereof and has a plurality of nozzles **140** spaced therealong. Hence, the cleaning solution can flow into the cleaning apparatus **100** through the piping **145** and thereafter sprays onto the pillared device directly via the nozzles **140**.

[0026] Referring to FIG. **4** and FIG. **2**, a set of bolsters **150** are disposed upon the base **102** and flank the outer tank **110**. In other words, the outer tank **110** is located between the bolsters **150**. Upper edges of opposing bolsters **150** are seen to include respective second openings **150c** for supporting the shaft **190** of the pillared device **180** mentioned above.

[0027] A motor **160** and a tail stock **170** are constructed further on the base **102** by having the outer tank **110** and the supports **150** position in between. As shown in FIG. **4**, one end of the shaft **190** is stuck into a driving portion **160b** constructed on a sidewall **160a** of the motor **160**, and the other end of the shaft **190** pairs a dead center **170a** of the tail stock **170** so that the shaft **190** can turn with the driving portion **160b**.

[0028] The present invention also provides a preferred method of cleaning the pillared device **180** respective to the aforesaid cleaning apparatus **100**. Firstly, the pillared device **180** is immersed into a first solution in the inner tank **120**, wherein a shaft **190**

extending out from two ends of the pillared device **180** passes through the first openings **110c** and the second openings **150a** and is further supported by the bolsters **150**. It is noted that at least a potion of the pillared device **180** is immersed into the first cleaning solution. One end of the shaft **190** is stuck into the driving portion **160b** and the other end thereof tipped by the dead center **170a** of the tail stock **170**. In the present invention, the pillared device **180** can be a roller used for coating an alignment film over a glass substrate described above, a taped shaft, or any that has a pillar configuration. The first cleaning solution can be a diluted potassium peroxide solution, a saline, or any solution for dipping purposes.

[0029] Next, the lid **130** is applied to shield onto the top of the outer tank **110**. The motor **160** is then activated and a rotational speed thereof is provided to rotate the pillared device **180** about the shaft **190**. Hence, the pillared device **180** can react with the first cleaning solution for removing process particles adhere thereon. After cleaning the pillared device **180**, the first cleaning solution in the inner tank **120** is discharged via the first outlet **120d** and the conduit **120e**. In the present invention, the first cleaning solution can be recycled for future usage.

[0030] Further, the nozzles **140** constructed in the interior of the lid **130** is turned on to spray a second cleaning solution directly onto the rotating pillared device **180** for diluting the first cleaning solution remaining thereon. In a preferred embodiment of the present invention, the second cleaning solution can be de-ioned water. It is noted that the outer tank **110** can be used for collecting the first and the second cleaning solutions splashing out of the inner tank **120**.

[0031] By providing the present invention, following advantages are obvious.

1. Since a portion of the pillared device is immersed into the first cleaning solution in the inner tank and reacts therewith by a physical motion, e.g. turning, the amount of the first cleaning solution can be effectively saved.
2. In addition, the first cleaning solution can be recycled, and so the cost of the cleaning process can be reduced.
3. Further, because the rotational speed of the motor is adjustable, the cleaning performance can present a better control.
4. Moreover, the cost and the time for shutting down the facilities having the pillared device can be substantially reduced.

[0032] While the preferred embodiment of the invention has been illustrated and described, it is appreciated that various changes and modifications can be made therein without departing from the spirit and scope of the invention.